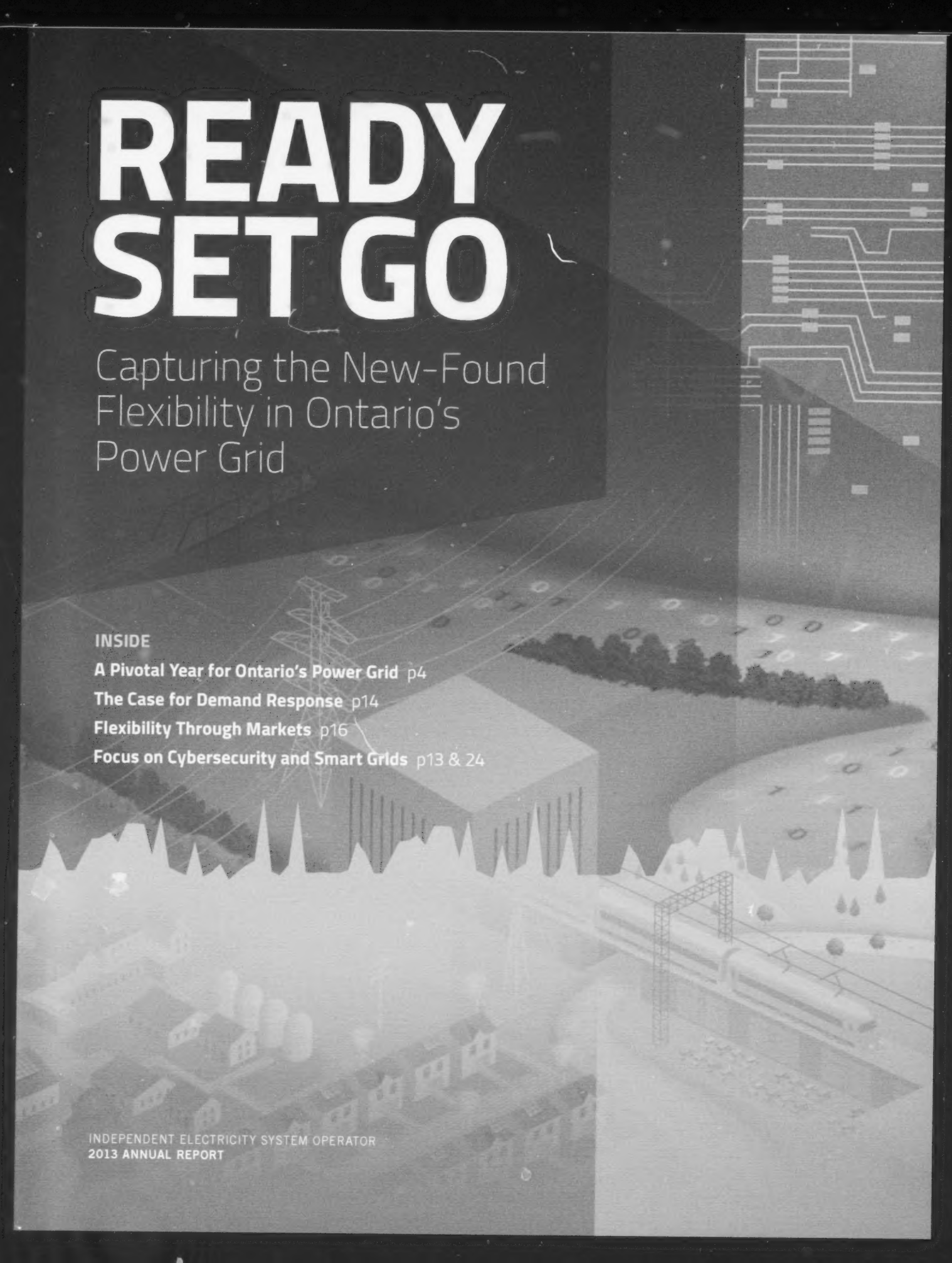
READY SET GO

Capturing the New-Found Flexibility in Ontario's Power Grid



INSIDE

A Pivotal Year for Ontario's Power Grid p4

The Case for Demand Response p14

Flexibility Through Markets p16

Focus on Cybersecurity and Smart Grids p13 & 24

INDEPENDENT ELECTRICITY SYSTEM OPERATOR
2013 ANNUAL REPORT

In this Report

INTRODUCTION

2 From the Chairman of the Board
Tim O'Neill on making sound decisions through stakeholder collaboration and transparency

4 Taking Stock: The IESO and Ontario's Changing Grid
By Bruce Campbell, IESO President and CEO

SNAPSHOTS

3 A Year in Review, Illustrated
Facts and figures from 2013

5 Behind the Scenes at the IESO
Get to know IESO employees

12 Before & After: Unleashing the Flexibility of Wind
Looking at the changing role of wind generation in Ontario's electricity system

14 The Case for Demand Response
New opportunities for consumers to have more control over their energy use and contribute to reliability

22 Evolving to a More Efficient Electricity Marketplace
Stakeholder consultation at the IESO

25 A 360° View: Stakeholder Perspectives
Stakeholders share their views on lessons learned and the future of the industry

28 Five Ways to Engage with the IESO

TECHNOLOGY

13 Emerging Challenges: Cybersecurity
Addressing the emerging risk of cyberattacks

24 Ontario's Smart Grid – Five Years On
Countries are going head-to-head to become smart grid leaders

FEATURES

RESILIENCY IN AN AGE OF CHANGE

A look back at how the IESO managed reliability and system operations in 2013.

6

LOOKING AHEAD – FLEXIBILITY THROUGH MARKETS

"Certainty in operations will be a rarity." The IESO and its stakeholders examine how the industry can evolve to become more flexible in the face of change.

16

2013 FINANCIAL STATEMENTS

See inside back cover

From the Chairman of the Board

The year 2013 was one of great progress. Much of the planning and preparation made by the IESO over recent years came into effect at precisely the right moment.

This year's annual report gives readers an overview of the sector, where we can look back to see how far we've come, and look forward to the coming year and beyond to the goals that lie ahead. We can zero in on the issues that matter the most and – in this new magazine-style format – examine them at length.

What I've found most interesting over the past year is the discussion of new opportunities and the choices we have to make to shape a more competitive and efficient electricity system.

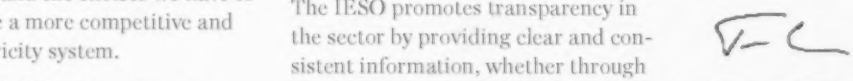
For 2014, the IESO will continue to update its business, operating procedures and tools to provide the flexibility needed to adapt to the ongoing changes to Ontario's power system.

Achieving success will be challenging and complex, and not without risk. While new technologies can give us more options and benefits, they can also create uncertainties and unintended consequences.

The way to manage this complexity is, of course, through a commitment to working with our stakeholders in a visible and collaborative way. Transparency is central to effective stakeholder engagement.

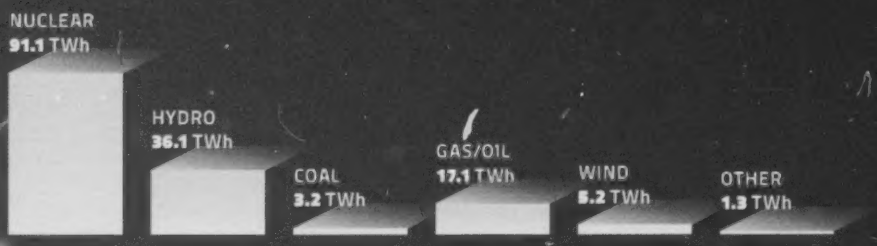
The IESO promotes transparency in the sector by providing clear and consistent information, whether through this report, our stakeholder engagement initiatives or our new website. These initiatives stress robust information and provide context for this information to help enable sound decision-making.

This culture of consultation and collaboration starts at the top. The Board of Directors and senior management value healthy discussion and the sharing of opinions among each other and stakeholders. It helps drive better decision-making for the organization and the industry, and provide the best value for the ratepayers of Ontario.



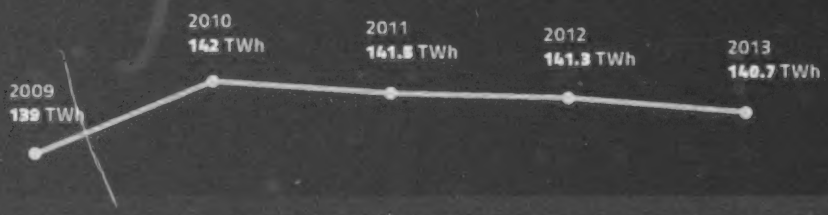
Tim O'Neill
Chairman of the Board
Independent Electricity System Operator

TOTAL ANNUAL ONTARIO ENERGY OUTPUT BY FUEL TYPE



TOTAL ONTARIO ENERGY DEMAND (2009-2013)

Demand has remained flat the past few years as economic and population growth has been mitigated by expanded embedded generation, demand response and conservation.



+18.3 TWh
Exports

+4.9 TWh
Imports

ELECTRICITY IMPORTS FROM NEIGHBOURING JURISDICTIONS WERE UP SLIGHTLY TO 4.9 TERAWATT HOURS (TWH) IN 2013, WHILE EXPORTS ROSE TO 18.3 TWH.

JULY 8, 2013
Severe floods resulted in a demand drop of approximately 3,800 MW as thousands of customers lost electricity service across the GTA.

8.57¢/kWh
Total cost of power in 2013. This cost includes the average weighted wholesale market price of 2.65 cents/kWh and the average Global Adjustment of 5.92 cents/kWh.

NUCLEAR'S TOTAL ENERGY OUTPUT
Increased from **82.5** TWh in 2009 to **91.1** TWh in 2013.

WIND CONTRIBUTION TO TOTAL ENERGY OUTPUT
Increased from **1.6**% in 2009 to **3.4**% in 2013.

2013 A YEAR IN REVIEW, ILLUSTRATED

Taking Stock: The IESO and Ontario's Changing Grid

Ontario's electricity sector is at a pivotal point.

The supply shortages the province experienced a decade ago have been addressed through the addition of approximately 12,000 MW of new and refurbished supply. The addition of more than 1,700 MW of variable generation to the grid was anticipated and addressed through numerous operational innovations, including new dispatch capability, a new online limit derivation tool and energy modelling software.

At the same time, demand growth for electricity is expected to remain relatively flat over the next few years, with reduced expectations over the longer term.

The increased uptake of variable generation sources, the changing characteristics of the demand side of the market and the significant variability in system conditions over short periods of time all require increased flexibility in our power system. Our grid operations have indeed entered a new era.

Flexibility is a key principle of the Long-Term Energy Plan (LTEP) published in late 2013 – flexibility to meet the evolving changes in the demand forecast, and flexibility to address the variability of a power system heavily invested in wind and solar resources.

Flexibility from both supply and demand resources will help keep the system reliable and improve the efficiency of the market while helping us meet an increasing array of challenges.

Today's positive demand-supply outlook is expected to continue for the next few years, offering us a window of opportunity to lay the groundwork for meaningful developments that are needed to enhance the resiliency of the system and of our markets.

Three specific recommendations in the LTEP will help provide the needed flexibility: demand response, storage and capacity markets.

The IESO has long been an advocate of **demand response**. We believe there are opportunities for increased participation from the demand side in Ontario's electricity market. By participating in this way, customers not only help meet system needs, they also help manage some of the cost pressures they face.

The IESO is committed to exploring the significant potential for **storage** solutions in Ontario's electricity market. In 2014, we will have two new storage providers of regulation services. Consistent with the LTEP, we are also seeking another 35 MW of storage projects for ancillary services and to gain experience with the operation of storage resources on the system.

Capacity markets elsewhere have shown that they can provide flexibility in the short and medium term. A capacity market with annual auctions for resources to compete to meet short- and medium-term needs could complement long-term planning and procurement, giving us greater flexibility to adjust to changing system needs without making unnecessary long-term commitments that could prove costly to consumers.

Given the positive experiences of neighbouring jurisdictions, the IESO believes it is worth exploring opportunities to develop an Ontario capacity market mechanism that fits within the provincial market construct.

While the LTEP sets out important roles and responsibilities for the IESO and other agencies, there is more change on the horizon.

Shortly after becoming President and CEO of the IESO in 2013, I was asked to chair the Ontario Smart Grid Forum, a body whose work the IESO has supported and led for approximately six years.

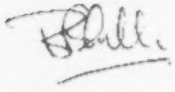
Over the course of discussions at the Forum, we now recognize that what we call smart grid could in fact challenge the fundamental role of every segment of the electricity value chain – from bulk generation and transmission to distribution and ultimately, consumption.

There are many drivers contributing to this change: solar power is cheaper than ever, a role for storage is emerging, and microgrids are becoming increasingly attractive complements to the more traditional service arrangements.

In 2014, the IESO will expand its dialogue with utilities and other potential new entrants to the smart grid space. Together, we need to better identify and assess technology-driven developments like distributed optimization, transactive energy and other such innovations.

The IESO will celebrate its 15-year anniversary in 2014. For a decade and a half, our employees have carried on the proud tradition of our predecessors while adapting to a changing electricity sector with differing customer needs.

It is clear that Ontario's electricity sector is in the midst of significant change. At the IESO, we see these developments as positive new opportunities – and we are determined to do our part to capture these benefits for Ontario.



Bruce Campbell
President and Chief Executive Officer
Independent Electricity System Operator

BEHIND THE SCENES AT THE IESO

Get to know IESO employees and how they contribute to the reliability and efficiency of the power system in their daily work.

JIM VERT

When Jim Vert makes a real-time decision about Ontario's bulk electricity grid, no one can overrule him – not even the President of the IESO.

Vert and his fellow control room superintendents have ultimate control over the system while they're on shift, authority that's needed to make scores of critical decisions aimed at keeping the lights on safely.

The role requires a calm demeanour, sound judgement, a rigorous work ethic and extensive knowledge of Ontario's power system. Vert has 23 years' experience in the control room.

Even so, his training never stops, with approximately 15 formal sessions per year in addition to daily briefings on system conditions and operator actions. This training is important for Vert and his colleagues, given that their real-time decisions are often made with limited information.

"We usually don't know exactly what happened or why until days after the fact," he says.

Vert is not daunted by the fact that he has the final word while on shift.

"You sort of get used to it," he says, adding, "I don't make decisions in isolation. I get feedback from many different sources as issues evolve. It's a real team effort. We do well when we're working together."

RUSSEL MASCARENHAS

Russel Mascarenhas is using his co-op placement at the IESO to apply classroom teachings in optimization to real-world problems.

Mascarenhas, an industrial engineering student at the University of Toronto, works as a junior market analyst for the Market Assessment and Compliance Division. There, he processes computerized simulations of various market conditions to help his team assess the various impacts of market participant conduct.

The experience is paying off.

"In school you are assigned a project, you do it once and that's it," he says. "Here it's more of a process. You get to go back and forth until you find a solution that meets everyone's needs."

Mascarenhas is one of approximately 25 co-op students at the IESO at any given time. Most of them perform four-month placements.

The students are drawn from a variety of programs such as finance, engineering and computer science from numerous Ontario colleges and universities.

"The program benefits both the students and the IESO," says François Dekytspotter, Manager of Human Resources at the IESO. "Co-op students bring a lot of enthusiasm and fresh thinking to their roles. As a result, we've seen their contributions grow over the years."

DAN ALEXANDRU

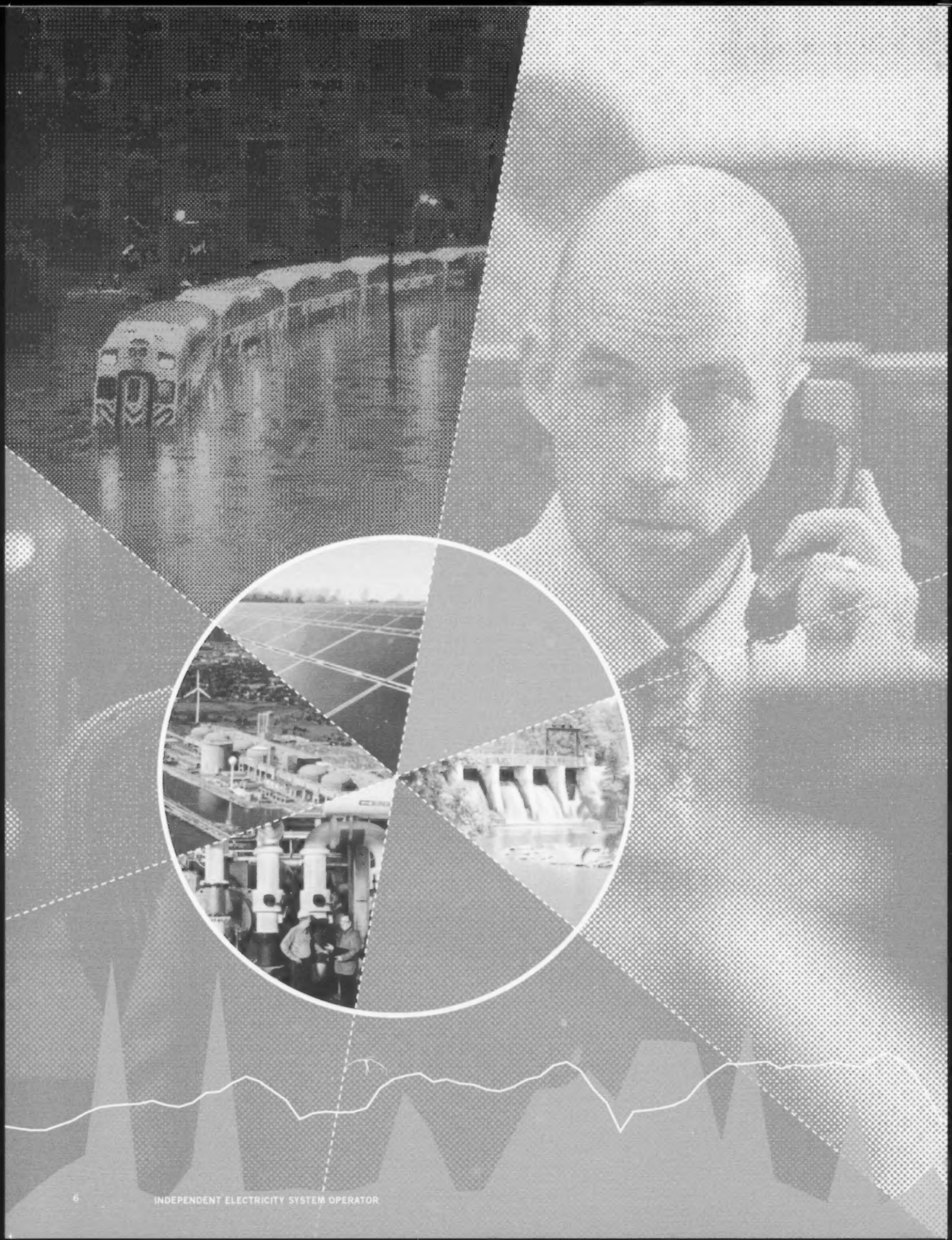
The variety in Dan Alexandru's workload is both one of his biggest challenges and one of the things he likes best.

Alexandru is a settlement coordinator for the IESO's Meter Data Management group.

Each day, his team collects and validates data from more than 4,000 wholesale meters and makes sure it's ready for settlement.

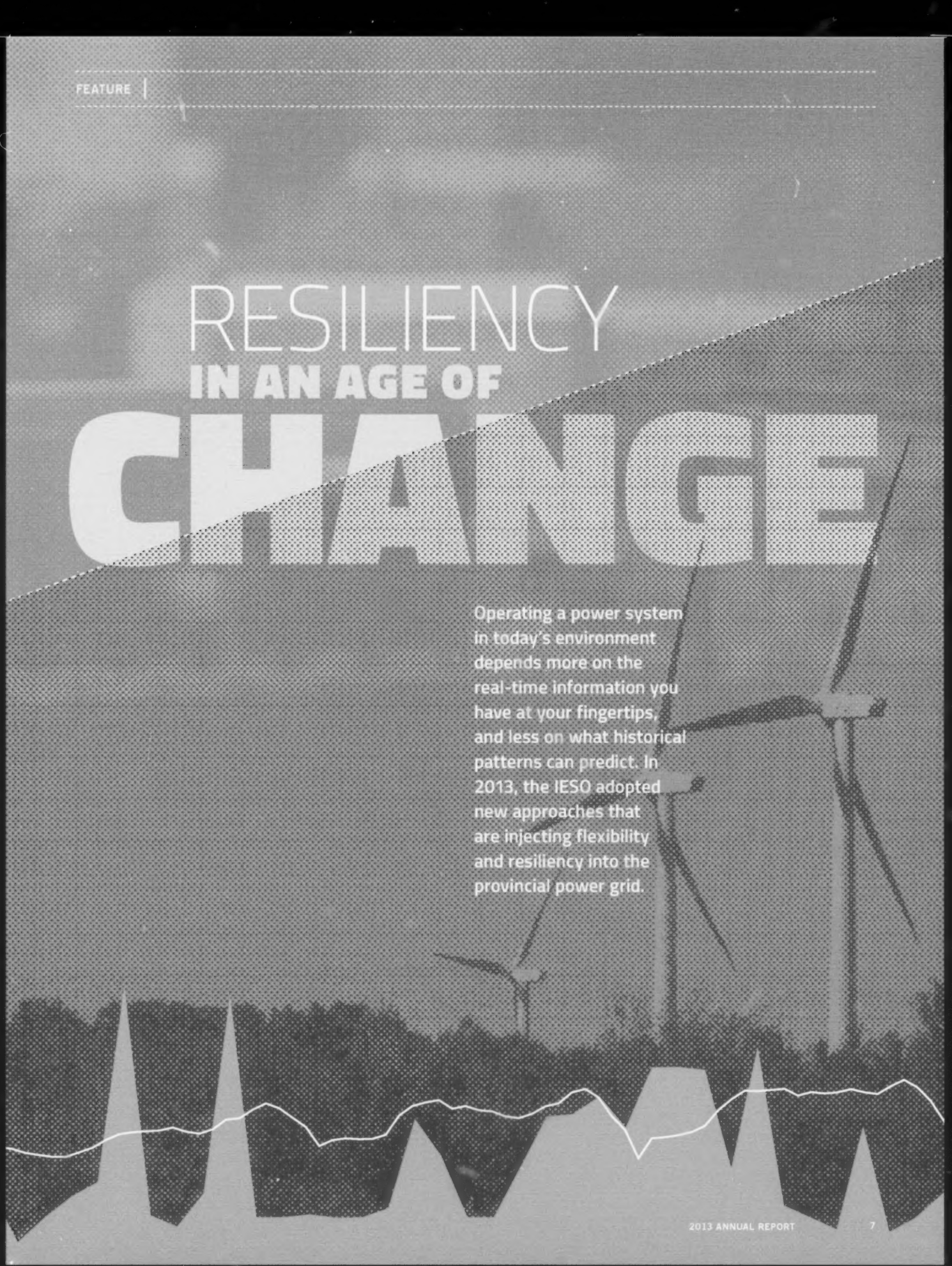
Alexandru also troubleshoots issues market participants may have with their data.

"I enjoy the fact that we don't know what tomorrow is going to bring, but one of the challenges is that I have to handle unexpected changes to our workload," he says. "I help with some of the more complex issues, so I can get pulled aside to assist various colleagues at any time."



RESILIENCY IN AN AGE OF CHANGE

Operating a power system in today's environment depends more on the real-time information you have at your fingertips, and less on what historical patterns can predict. In 2013, the IESO adopted new approaches that are injecting flexibility and resiliency into the provincial power grid.



A late-summer heat wave that began on September 10, 2013 was a welcome surprise to many Ontarians. Patios across the province were bustling with business that day, as people enjoyed the last rays of summer before fall. In the provincial capital, temperatures reached into the 30s, accompanied by high humidity and nearly doubling the nighttime high.

In the IESO control room, operators were contending with what could become an increasingly common event – a one-day 10,000 megawatt (MW) swing in demand.

The event required operators to turn on a dime, shifting their focus from surplus management in the early morning to a potential shortage just hours later. Every available generating unit in the province was pressed into service.

It wasn't that long ago that the operators of Ontario's bulk electricity system were able to rely on decades of tried and true methodologies to help guide them through challenges like the ones posed on that day in September. Extreme fluctuations in supply and demand were less frequent and largely predictable events in those days. Operators had time and years of historical data to rely on.

In 2013, however, the IESO's operating environment was marked by complexity and constant change. There were many instances when the province moved from surplus to potential shortages and back to surplus – all within the same day. At another time, an overloaded circuit in a faraway jurisdiction in Virginia caused ripples that reached all the way into the IESO control room.

This dynamic environment is now considered the 'new normal' for the IESO and is redefining the organization's behaviour, challenging its assumptions and opening the door to new possibilities.

Ontario's New Electricity Landscape

Numerous factors are reshaping the current landscape. The IESO has dozens of new market participants, new technologies and, at times, extreme variations in both supply capability and demand. At the same time, Ontario's reconfigured asset base includes a coal fleet that is in the final stages of being phased out, new natural gas-fired resources, a full nuclear fleet and the addition of large amounts of renewable generation – changes that, all told, amount to lost flexibility that must be found in new places and in new ways.

These changes, while transformative, are not unexpected. The role of the IESO as system operator is to ensure reliability of supply through the market while keeping the grid in balance, regardless of external circumstances. That balancing process starts months – and years – in advance.

Over the past few years, the IESO identified emerging pattern shifts and planned for their onset. Through a steady process of revision, redesign and addition, the organization revamped its real-time operating methods, tools and training programs to prepare for these changes.

THIS INCREASINGLY COMPLEX, INTERWOVEN SYSTEM REQUIRES CREATIVE NEW SOLUTIONS.

From Study to Consultation to Implementation

Many of these tools became operational at precisely the right moment.

For example, security constraints that serve as speed limits for the flow of electricity throughout the province were modernized from rigid and conservative calculations into more dynamic ones. With the Online Limit Derivation tool, the IESO now has the ability to calculate operating limits in close to real time, taking into account dynamic and constantly shifting parameters. The IESO can therefore allow much more power to flow through specific points on the grid, reducing congestion and increasing operational flexibility.

This new tool took centre stage in July 2013, when a record rainfall in the Greater Toronto Area flooded two major high-voltage transformer stations. The transformer stations were taken out of service, ultimately leading to the loss of 3,800 MW of demand – the third-largest such interruption in Ontario's history, behind the province-wide blackouts of 1965 and 2003.

In the past, restoration efforts would have relied on staff experience and partial simulations. The Online Limit Derivation tool changed that, allowing system limit experts to capture the full state of the power system and immediately begin studies using an exact model of the system. Less time was spent on modelling and more time on analysis of the power system.

While the tool laid the groundwork for a speedier restoration process, the restoration effort itself was a collaborative one. The transmitter and other affected local distribution companies worked diligently to effectively restore all 32 high-voltage circuits. Their work was widely praised, for good reason.

Internally, the effectiveness of the Online Limit Derivation tool in a real-time contingency is now prompting the IESO to consider widening its application in emergency procedures.

Another, more visible addition was the Renewable Integration Initiative (RII), which added a suite of enhancements designed for large amounts of new variable generation resources. Thanks to strong collaboration with stakeholders and agency partners, the RII introduced three significant new features: forecasts, visibility and a new dispatch tool.

Forecasts predict output from wind and solar facilities, using real-time information from hundreds of weather and other monitoring stations as well as output information from registered generators. This rolling projection has added critical information to the IESO's decision-making ability, giving operators substantially more confidence in their operation of grid-connected wind resources, with solar resources soon to be added.

Visibility gives operators an instant glance at output from grid-connected and larger distribution-connected variable resources on the system. This knowledge will gain in importance, with an expected doubling of embedded variable generation resources in the next 18 months.

- 3,000 MW

THE AMOUNT OF COAL GENERATING RESOURCES REMOVED FROM THE GRID IN 2013, MARKING THE CULMINATION OF AN ORDERLY AND RELIABLE PHASE-OUT OF COAL IN SOUTHERN ONTARIO.

BEHIND THE SCENES AT THE IESO

JOANNE HOSICK

JoAnne Hosick, an engineer/ technical officer in the IESO's System Performance & Models group, is living proof that the transition from astronomy to power system engineering is not as far-fetched as one might think.

Hosick supplemented her master's degree in astronomy with a degree in power system engineering after working for a spell in the Hydro One control room.

At the IESO, she is part of a team that performs thousands of simulations to determine potential limitations in the power system. The team then codes those limitations into mathematical equations. The equations are entered into real-time monitoring tools designed to set off alarms when the system approaches its limits.

"The complexity of this work is extremely high, as is the responsibility," says Ioan Agavriloai, manager of Hosick's group. "Any error could have serious consequences for reliability."

Surprisingly, Hosick says her time studying celestial objects left her well prepared for her current role.

"My work in astronomy was mainly running simulations of galaxy mergers, which use a lot of the same numerical methods we use at the IESO," she says. "So the transition from astronomy made a lot of sense for me."

ENERGY OUTPUT AND INSTALLED CAPACITY BY FUEL TYPE 2013

Nuclear	91.1 TWh	12,947 MW
Hydro	36.1	7,939
Gas/Oil	17.1	9,920
Wind	5.2	1,725
Coal	3.2	306
Other	1.3	124

*As of December 31, 2013

The new dispatch tool for all grid-connected variable resources gives operators the ability to quickly adjust hundreds of megawatts of power to deal with rapidly changing system conditions.

The dispatch tool has become indispensable in helping to manage surplus situations. It has even been used to follow demand as it fluctuates throughout the day.

More importantly, it has helped the IESO meet its critical grid management responsibilities. Dispatch helped when an overloaded circuit in Virginia resulted in unexpected cuts to Ontario exports, resulting in a sudden surplus. Similarly, when a 500-kilovolt line in Southwestern Ontario was forced from service unexpectedly, operators dispatched both wind and nuclear resources to meet interconnection responsibilities in re-preparing the grid.

Without wind dispatch, large generating resources such as nuclear units would be shut down more frequently, taking more generation offline than is needed to solve short-term surpluses, resulting in a complicated and costly process.

New energy modelling software that became operational in 2013 will capture a broader spectrum of transmission constraints and characteristics of resources that allows for hourly evaluations of system adequacy, enhancing the IESO's planning processes.

Better, more comprehensive information is another key to understanding and adjusting to changes in Ontario's electricity infrastructure and supply mix. In this environment, enhanced knowledge translates into planning flexibility, which in turn creates grid resiliency.

Tapping Unused Flexibility

The IESO took another step forward in 2013 by entering into agreements and integrating emerging alternative technologies into Ontario's electricity regulation market. Following a competitive procurement process, three proponents were selected to provide a total of 10 MW from alternative sources of regulation, specifically from aggregated load, battery storage and flywheels.

One of these proponents is working to harness pre-existing flexibility by allowing companies with automated heating and cooling systems and other processes to offer that flexibility to the market. Those companies will respond to IESO signals by momentarily increasing or reducing their usage – without affecting their own processes.

All of these changes, representing a relatively small investment, are the product of extensive consultation with sector partners, including market participants, as well as the hard work of IESO staff, who have shown a great degree of flexibility in adapting to its new operational realities.

System Performance

The results of all these changes are notable, and play out every day in real time. Despite a high degree of complexity and change, Ontario's bulk electricity system performed well in 2013.

AUGUST 14, 2003: THE DAY THE GRID WENT DOWN

The province's electricity system has changed a lot since the blackout of 2003. Ten years on, it's more complex and diverse, with 8,000 MW of new and 4,100 MW of refurbished generation brought into service. The IESO also has a clearer picture of activity in neighbouring jurisdictions. And the entire North American grid is now held to higher, mandatory reliability requirements. Regulatory standards are more specific about the roles and responsibilities of system and transmission operators and are monitored and enforced through sanctions. Despite these new measures, ask Chief Operating Officer Kim Warren if a major blackout like 2003 could ever happen again and he'll say: "It is much less likely, but we never say never."

12

AVERAGE NUMBER OF TORNADOES ONTARIO GETS EVERY YEAR. IN ANTICIPATION OF TORNADOES AND OTHER EXTREME WEATHER EVENTS, IESO OPERATORS REPOSTURE THE GRID TO LIMIT THE IMPACT ON EQUIPMENT AND RELIABILITY.

LONG GONE ARE THE DAYS OF PREDICTABLE FLOWS, PATTERNS AND USEFUL HISTORICAL TRENDS.

The IESO and its market participants were able to effectively manage the high degree of intraday fluctuations in supply and demand and address the challenges posed by extreme weather events. Demand response played an increasingly prominent role in helping to balance the system, providing a combined 1,200 MW of demand reduction on the hottest days of the year.

The province's interconnections continued to act as a large shock absorber, allowing interconnected jurisdictions experiencing tight supplies to import power, while allowing others in oversupply to export. The province effectively exported electricity throughout 2013 and did not depend on imports to maintain reliability at any point during the year.

A Subtle Shift

Ontario has made great strides in its supply outlook by adding new renewable generation, natural gas infrastructure and new transmission to the market, in addition to increased demand response and new technologies such as storage. However, it has also lost considerable amounts of flexible generation. A full 3,000 MW of coal generation was retired in 2013 alone.

Both the addition and elimination of resources were done in an orderly, controlled process, with no impact on reliability. Nevertheless, a shift continues to take place.

During the next several years, large swathes of nuclear generation will cycle out of service for refurbishment. Ontario is transitioning from a period of ample supply to a period of adequate supply. Despite that fact, surplus baseload generation events will continue.

The IESO continues to aggressively pursue efficient solutions to new challenges. Recent investments will soon yield new demand forecasting capabilities, outage management protocols and operator training simulations to help the organization with these tasks.

Other solutions are further out on the horizon. System operators require an even broader view of system conditions in other interconnected jurisdictions to reduce the likelihood that incidents occurring hundreds of kilometres away will impact the Ontario power system.

In 2013, increased complexity and constant change were the prevailing themes at the IESO. Ontario's increasingly complex, interwoven system will continue to require creative solutions in 2014 and beyond.

+160% in 5 years

APPROXIMATE PERCENTAGE INCREASE IN GAS GENERATOR CAPACITY BETWEEN 2008 AND 2013, HIGHLIGHTING THE RELATIVELY YOUNG AGE OF ONTARIO'S GAS GENERATION FLEET. GENERATING CAPACITY ROSE BY 4,800 MW OVER THAT TIME, AS EIGHT NEW STATIONS WERE ADDED.

BEHIND THE SCENES AT THE IESO

JENNIFER CUI

Just as it is for an emergency room physician, being on call is part of Jennifer Cui's job. But her operations are performed on complicated computer systems. And her scalpel is a laptop.

Cui, an electrical engineer, works on a range of software that helps the system run – software that contains all the bids and offers, for example, or that signals alarms when the system is approaching its operating limits.

"We work closely with our vendors and other teams within the business," she says. "If there's a situation with an application – if the flow calculations aren't converging, for example – we work with people in the Operations group as well as our vendors to pinpoint the root cause."

One week in five Cui is on call, ready to tackle complex problems at any time of day – or night.

"You always have to have your phone by your side," she says.

MEGAN DONER

University graduates with business degrees are in for tough competition in the job market. So Megan Doner, an assistant engineer/ technical officer at the IESO, put herself at an advantage by earning a second concurrent degree in computer science.

At the IESO, Doner is putting both degrees to good use in her work for the Market Settlements group where, in addition to other tasks, she ensures the accuracy of billing for the IESO market.

Her business background helps give her an in-depth understanding of the market. Computer science gives her the tools to transform "a substantial amount of raw data into meaningful information."

BEFORE & AFTER UNLEASHING THE FLEXIBILITY OF WIND

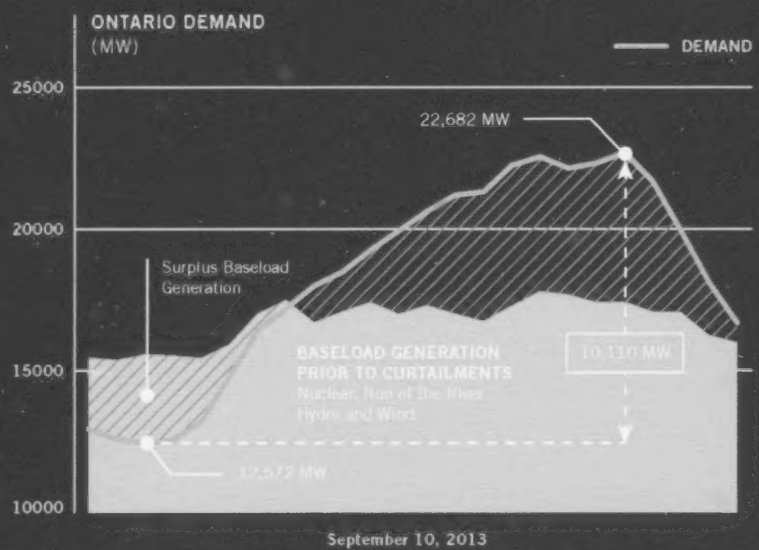
Wind generation has taken on a whole new role in the Ontario electricity system – moving from a passive resource to one that is actively used to balance supply against demand. The dispatch of wind has become an effective tool to manage surplus baseload generation.

BEFORE

SEPTEMBER 10, 2013

On the day before implementation of wind dispatch, system conditions were a precursor of what will become an increasingly common occurrence – shortfalls and surpluses on the same day – with demand increasing more than 10,000 MW over the course of the day. And while large shifts in demand on the same day have happened before, surplus baseload generation had never been part of the mix.

At first, the IESO control room managed the surplus through exports and reducing nuclear output, which is a cumbersome and inefficient process. As temperatures and demand rose, system operators shifted from managing surpluses to ensuring there was enough supply to meet afternoon peaks.



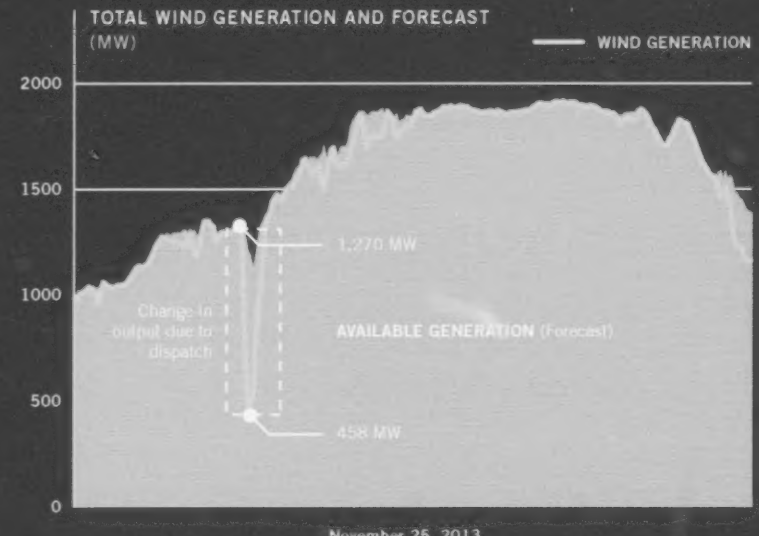
September 10, 2013

AFTER

NOVEMBER 25, 2013

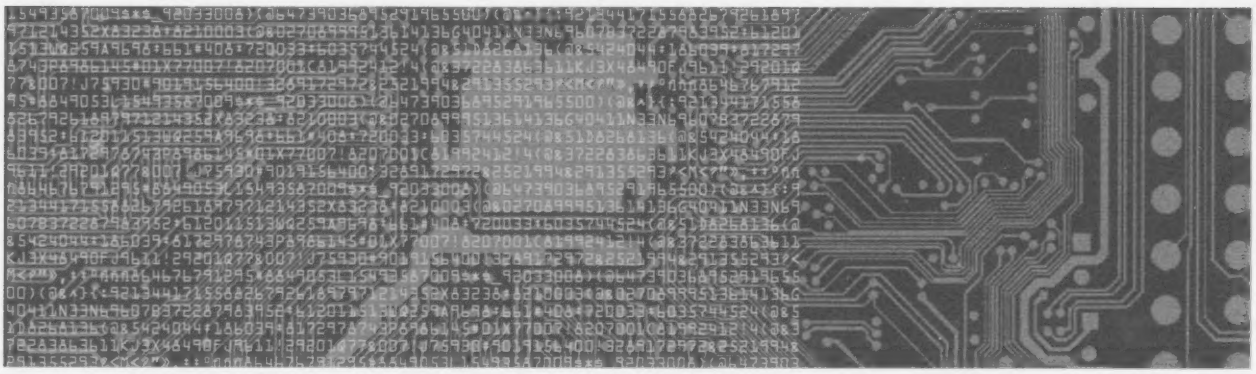
Once wind dispatch came into effect, the IESO was able to use the inherent flexibility of wind generation to help balance demand. When the wind is blowing, wind generators have proven to be highly flexible, with the potential of changing their output at a rate seven times that of gas facilities.

On November 25, wind generators played an important role in managing surpluses. At one point, wind output was reduced by more than 800 MW within 15 minutes, then increased by the same amount. Throughout the day, wind generation provided valuable 'load following' responding to the changing needs of the system and market.



November 25, 2013

Emerging Challenges: Cybersecurity



National Geographic's *American Blackout*, a dramatic portrayal of a large-scale power outage broadcast in 2013, is a reminder of the emerging risk posed by cybersecurity threats.

In this fictional national power outage, store shelves are empty and fuel supplies have evaporated. Increasingly desperate citizens roam the streets, looking for food, fresh water and anything else that may help them survive.

And all of it is caused by a cyberattack that could have been staged with a couple of thousand dollars in computer equipment.

The production's worst-case scenario premise may be extreme, but the fact remains that cyberattacks are posing new challenges to businesses in an array of sectors. Over the past decade, computer-generated attacks have increased in number, complexity and consequences.

As an organization with responsibility for critical infrastructure, the IESO takes cybersecurity very seriously, actively working to secure the grid against cyberattacks, and monitoring threats and vulnerabilities on a continuous basis.

To do this, the IESO employs a specialized team of cybersecurity experts who are all Certified Information System Security Professional (CISSP) trained and compliant. The IESO also complies with a variety of North American Electric Reliability Corporation (NERC) standards governing the protection of critical infrastructure.

Through its extensive emergency planning experience, the IESO has developed mitigation plans for critical situations, including cyberattacks, physical attacks and extreme weather events.

In November 2013, the IESO participated in GridEx II, a continent-wide exercise that simulated a coordinated physical and cyberattack. The IESO took the Ontario exercise one step further than other jurisdictions by involving security and other agencies not directly involved in the electricity sector. The exercise gave IESO staff an important opportunity to practise real-time crisis response.

However, the IESO's efforts alone cannot eliminate risks to Ontario's power grid, which connects with hundreds of transmitters, distributors, generators and large consumers. Cybersecurity is a shared responsibility.

Recognizing this, the IESO has taken steps to promote better information-sharing among industry participants. Those efforts include, most recently, the establishment of the Cybersecurity Forum in late 2013. The Forum aims to increase awareness of cybersecurity initiatives, develop and collaborate on best practices and review current information about incidents.

"A big part of our efforts involves staying current," says Ben Blakely, team lead with the IESO's Security group and Chair of the Cybersecurity Forum. "We identify threats and solutions to those threats by collaborating and sharing information with industry members, as well as agencies such as NERC and the Canadian Cyber Incident Response Centre."

Always important, information-sharing has been given additional impetus after security experts remarked that perpetrators of cyberattacks use many of the same resources – servers and programming code, for example – in successive attacks.

In this context, information-sharing can be critical in protecting against future attacks.

THE CASE FOR DEMAND RESPONSE

Managing the power grid has traditionally been a matter of controlling supply output to meet changes in demand. Today, consumers can do the opposite by changing their consumption in response to prices that reflect system needs. This is called demand response.

Opportunities for demand response are growing. New technologies will allow consumers to have more control over their electricity use, manage their costs and contribute to system reliability.

THE ONTARIO EXPERIENCE

Ontario's system needs are constantly changing. Consumers can provide valuable flexibility through demand response.

There are 4.8 million smart meters allowing consumers to respond to time-of-use rates by shifting demand.

Ontario has a robust high-tech sector developing new products and services to help manage energy needs.

In managing the grid, the IESO schedules the lowest-cost generation to meet demand. If consumers offer reduced consumption into the market, more expensive generation may not be needed.

Demand response provides a valuable resource to Ontario. Over the hot summer days of 2013, it helped reduce peak demand by an average of 1,200 megawatts. This came from large industrial customers reducing their energy use during the five peak days of the year, the DR3 program, large consumers bidding for energy in the market (also known as dispatchable load) and time-of-use rates.

2025

The province's Long-Term Energy Plan sets a target of using demand response to meet 10 per cent of peak demand by 2025.

THE EVOLUTION OF DEMAND RESPONSE

In the Long-Term Energy Plan, the Ontario government tasked the IESO with evolving current programs and working with consumers to develop new initiatives for demand response.

Current Demand Response

Program-based demand response such as peaksaverPlus and DR3 are activated when the grid is under strain, usually during hot summer days.

Current demand response programs are mostly focused on managing demand peaks. Ontario has built a solid foundation from which to expand for more products and services.

Future Demand Response

Already, some large consumers are participating in the market, responding to wholesale prices. By expanding its role in the market, DR can actively participate on a level playing field with generators and energy traders to provide services like managing local or regional conditions or minute-to-minute balancing.

The IESO is taking a lead on investigating market-based opportunities to expand the role of demand-side resources. A new stakeholder working group has been established to support this effort. **www.ieso.ca/drwg**.

HIGHLY FLEXIBLE

Demand response takes advantage of existing infrastructure to provide services that in some cases have previously only been offered by generators, adding a highly flexible resource to support system reliability.

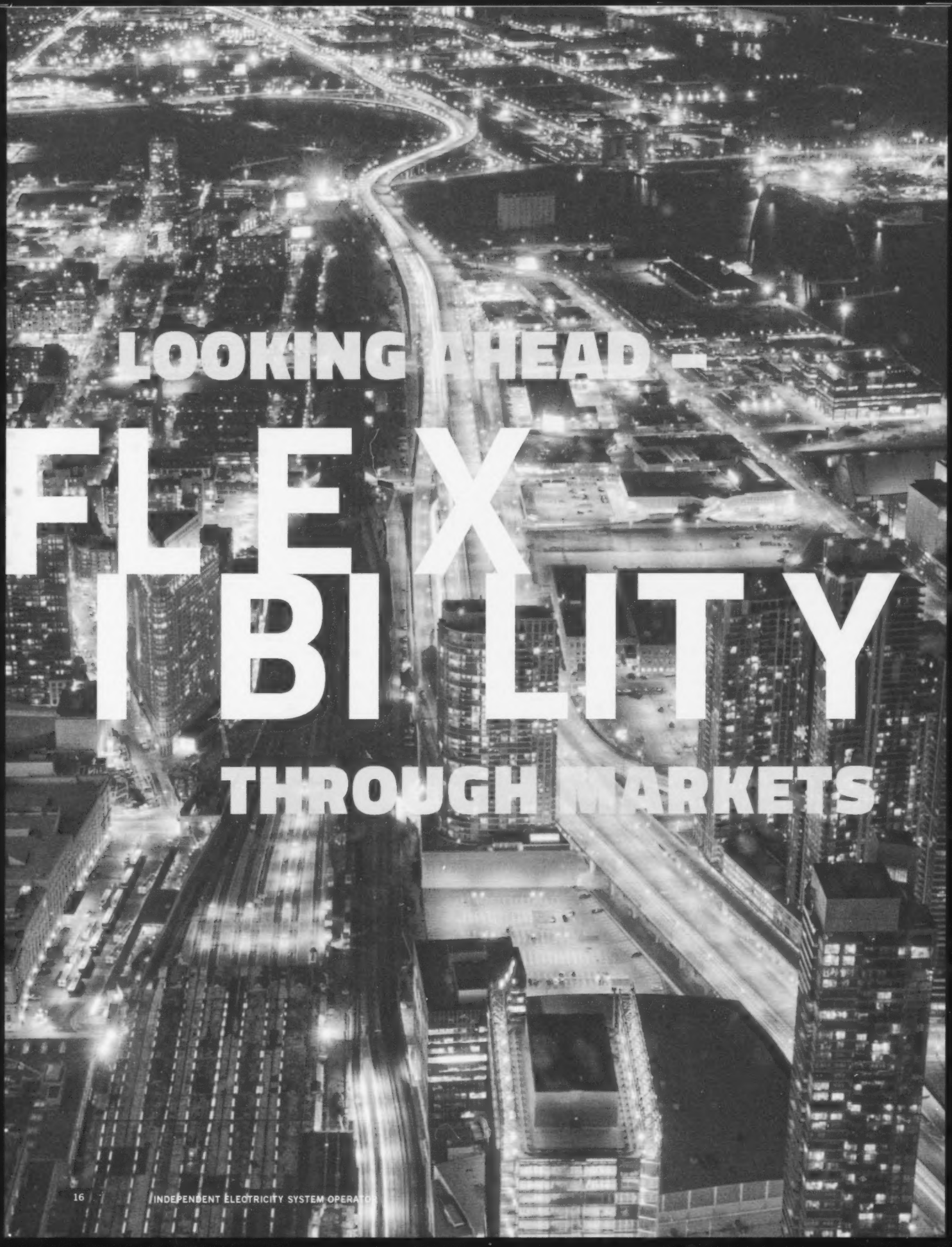
The IESO has recently launched a pilot program allowing institutional, commercial and industrial consumers to provide aggregated regulation service. In this way, demand response helps the grid maintain second-to-second balance, by responding to small and frequent changes in energy demand and generation.

LEARN MORE ONLINE

The Ontario Smart Grid is an interactive website that helps educate consumers on how their response to price and system signals can help grid reliability.

Visit **www.ieso.ca/ontariosmartgrid** to learn more.

Learn more about where we are now and the future of demand response by visiting the IESO website: **www.ieso.ca/demand.response**



LOOKING AHEAD – FLEXIBILITY THROUGH MARKETS

HOW CAN ONTARIO'S ELECTRICITY SYSTEM BECOME MORE RESPONSIVE, MORE EFFICIENT AND TAKE ADVANTAGE OF NEW OPPORTUNITIES – PROVIDING NEW-FOUND FLEXIBILITY TO HELP KEEP THE LIGHTS ON?

Today's Ontario electricity system is vastly different from what it was just 10 years ago. Wind is now a mainstream resource; solar panels in communities are displacing demand from the high-voltage grid; large industrial users are shaving summer peaks; and coal has virtually disappeared from the provincial energy landscape.

And more change is on the way. Increasing variable generation, the renewal of the provincial nuclear fleet and the emergence of game-changing technologies mean that change is continuous. The IESO and other stakeholders are looking at how to evolve current structures to become more flexible and better able to take advantage of evolving opportunities.

Organizations that have complex operational responsibilities are often driven by a singular value. As is the case at the IESO, when it comes to reliability, change must be carefully managed and controlled. These organizations analyze, assess and consult, taking the necessary time to design rules and structures that will ensure continuity and consistency.

As technology, entrepreneurship and consumer needs continue to evolve at breakneck speed, questions emerge: Can institutions change fast enough or are they destined to become roadblocks? Can they adapt existing structures to facilitate and foster change?

"For the IESO, our goal is not just to ensure that change doesn't impact reliability," says Bruce Campbell, President and CEO of the IESO. "We want to ensure that we can harness change to enhance reliability. And that means adapting the way we've structured the system so that it can attract innovation and new efficiencies that will make the entire system work better."

The Transformation Continues

Ontario's power grid has now reached the point where all the investments in new and refurbished supply have assured adequacy of the electricity supply.

BRUCE CAMPBELL, PRESIDENT AND CEO OF THE IESO:
"WE WANT TO ENSURE THAT WE CAN HARNESS CHANGE TO ENHANCE RELIABILITY."

In 2013, Ontario had more nuclear units available for service and operating than at any other time since market opening. Wind generation has at times provided as much as 13 per cent of the province's energy needs. With the 2013 introduction of wind dispatch, this zero-carbon resource has evolved to provide valuable flexibility, augmenting the supply flexibility provided by Ontario's new gas generators. These advances in supply have been accompanied by new opportunities for electricity consumers to manage their electricity use.

This ambitious program has been implemented through contracting investment in new generation, new transmission, amendments to market rules and the deployment of new technologies – all facilitated by a significant commitment to stakeholder engagement. In short, the sector acted decisively to put many key changes in place.

Yet looking forward, can the industry rely on the same tools to absorb continued change? Kim Warren, the IESO's Chief Operating Officer, views change as a constant, and one which requires a more fundamental response.

"Certainty in operations will be a rarity. We need practical and efficient means to manage the volatility we see within a day's or week's operations. Our current approaches may not be the answer to our problems as they have in the past."

While contracts and regulated rates for new and refurbished generation have been important tools in replacing Ontario's coal facilities and supporting investment in renewable energy, they can be difficult to adapt to rapidly changing circumstances. That's why the industry is exploring the evolution of market mechanisms – building on the inherent responsiveness of markets to address changing conditions in ways that both protect reliability and drive greater efficiencies.

The Future Ain't What it Used to Be

In 1989, Ontario Hydro forecast that primary energy demand in Ontario would near 200 terawatt hours by 2014. This forecast was based on sound planning methodologies, historical patterns and projections of how the population and economy would grow. The reality, however, is that total Ontario demand reached just 141 terawatt hours in 2013 and will likely remain at the same level in 2014.

The lesson here is not that the forecasts missed the mark, but that circumstances have changed so significantly that long-term plans can no longer be set in stone – they must be constantly adjusted and revised. The province's new Long-Term Energy Plan recognizes this reality, and will be assessed on an ongoing basis in the light of systematic energy statistical reports made available to the public to support broader, well-informed discussion.

Even in day-to-day operations, the level of predictability that system operators used to count on has dissipated, along with the value of historical trends and tested methodologies. They can be irrelevant – or worse, misleading – to the current day's operation. Grid operations are becoming more volatile and complex, with incidents increasing in scope and depth. And while the dispatch of wind generation and variable generation forecasting represent important tools for system operators, greater flexibility is still needed.

The Changes Ahead

The next few years will likely prove again that constant change has become a core feature of the province's electricity system. For example:

- Increasing amounts of both nuclear and renewable energy contributed to surplus baseload generation throughout 2013, and will continue to do so over the next few years. At the same time, daily variability will become more pronounced. By 2019, transmission-connected wind generation is expected to surpass 4,900 MW. This additional capacity will have the potential to both add to, and help manage, surplus baseload generation.
- Embedded solar and wind generation – output located within local distribution service areas – is expected to exceed 2,700 MW by 2019, adding increased variability to grid operations, with associated issues such as voltage control.
- A new round of nuclear refurbishments is slated to begin in 2016, representing more than 8,000 MW of generation, and 3,000 MW of generation at Pickering will be retired by 2020. As a result, the system will need to be regularly reconfigured to adapt to changing power flows as the refurbishment schedule unfolds. Other resources, such as natural gas generation, demand response and interconnections, will have to assume a greater role, once again changing the dynamics of balancing the grid.

Flexibility Through Markets

Since 2002, the wholesale electricity market has worked to balance supply and demand within the province through the price signal, which has brought generators, traders and large consumers together to determine the most efficient way to meet the province's supply needs on a five-minute basis. A great deal of experience has been gained over those years.

The cold weather throughout January 2014 showed just how flexible the market can be – and how the price signal can efficiently balance the market. With rising demand, market prices effectively attracted supply when and where it was needed most; and when there was surplus supply in Ontario, it provided generators with the opportunity to sell

BEHIND THE SCENES AT THE IESO

ANDY HE

Andy He, an economist with a PhD from Carleton University, has a unique perspective on the operation of Ontario's wholesale electricity market.

He has spent the bulk of his 11-year IESO career monitoring market operations, assessing market participant behaviour and identifying defects in market design.

In 2013, he switched jobs, moving from the Market Assessment and Compliance Division to Markets and Finance where, as a senior economist, he is now helping model and assess potential changes to Ontario's bulk electricity market. Among the issues he has looked at is the application of storage in other markets.

"It's very interesting," He says about the change in perspective. "I've moved to the other end. I'm providing input to market and program initiatives in order to increase efficiency and avoid adverse consequences in the first place."

RHONDA WRIGHT HILBIG

As a long-time leader at the IESO, Rhonda Wright Hilbig has played a role in its transformation into a customer-focused organization.

A mechanical engineer, Wright Hilbig began her career working at a coal generation plant in Southwestern Ontario. She was hired by the IESO at its inception and spent her early days in customer service, helping grid-connected customers integrate into the market. At the time, the IESO was an operations-focused organization.

Over time, that focus has shifted. "Now, it's customers first," she says.

Wright Hilbig recently took on the role of manager of market change initiatives, where she is responsible for spearheading the business and customer aspects of a market systems refresh and integrating demand response into the market.

She sees her latest role as a return to her roots. "I get to re-engage with consumers through programs that allow them to participate in the market," she says.

MOHAMED EL-MADHOUN

The opportunity to work directly with electricity sector partners is just one of the benefits of Mohamed El-Madhoun's job at the IESO.

El-Madhoun, a senior engineer/technical officer with the organization's Meter Data Management group, leads a team responsible for registering and auditing revenue meters in the IESO market.

Large producers and consumers of electricity use the revenue meters to measure all energy transactions into and out of the grid.

The registration process, which holds market participants to strict standards, takes a month or two.

"There's a lot of interaction with market participants," says El-Madhoun, who holds a B.Sc. in engineering. "You have to be a really good listener. You need to know exactly what their concerns are."

CAPACITY MARKETS ALSO OFFER THE FLEXIBILITY TO INTEGRATE INNOVATIONS SUCH AS ENERGY STORAGE AND OTHER EMERGING TECHNOLOGIES.

this surplus in export markets, bringing in revenues that offset capacity investments. During this period, the capacity payments that generators would have received through the Global Adjustment were significantly reduced, as wholesale prices worked to cover a greater share of the investment costs.

A Market-Based Approach

Given the flexibility that markets can provide, the IESO is examining ways to leverage markets further to build greater flexibility into the system – whether in day-to-day operations or in helping to meet some of the nearer-term capacity needs.

Demand response – consumers responding to system needs – provides the perfect argument for why markets need to adapt. Markets can tap into existing infrastructure created for other purposes in order to generate more flexibility from the demand side of the market. This can come in the form of peak shaving, load following or even second-to-second response.

Ontario already has experience with large consumers participating directly in the market. And now, with new technologies enabling consumers at all levels to take greater control of their energy use – whether on their own or through aggregators – the industry is seeking to capture the value that consumers can provide and developing ways to compensate them for that value. The aim is to put consumers, who want to better manage their electricity costs, on a level playing field with suppliers such as generators and energy traders.

Opening the market to broader participation is supported by efforts to increase the role of demand response in Ontario. The Long-Term Energy Plan sets a demand response target of 10 per cent of peak demand by 2025. In addition, it has called on the IESO to work with large electricity consumers on new initiatives that can put demand response efforts on par with other generation options in Ontario's electricity markets.

One of the ways in which the IESO could integrate greater levels of demand response is by developing capacity markets. Capacity markets can complement existing contracts and other procurement options by ensuring adequate supply without locking in that supply for a long period of time.

As the province faces the potential uncertainties associated with refurbishing the nuclear fleet, markets may allow system planners to more easily adjust for the ebb and flow of system needs at lower costs than long-term commitments made through contracts. A properly designed capacity market could deliver near-term flexibility to dynamically adjust to revised or unforeseen changes in demand and supply conditions.

Ted Leonard, the IESO's Vice President – Markets and Chief Financial Officer, is keen to bring to Ontario some of the lessons about capacity markets learned from neighbouring jurisdictions. "At a time when we are under significant cost pressures, I want to know: How have other markets drawn out further efficiencies? How have those markets put downward pressure on capacity prices? It's our responsibility to explore these developments to determine where the opportunities are."

The IESO is looking at the experiences of system operators in New York and New England, and also at PJM, which serves the Central East United States, to help determine if capacity markets can provide cost savings and increased levels of flexibility.

1961

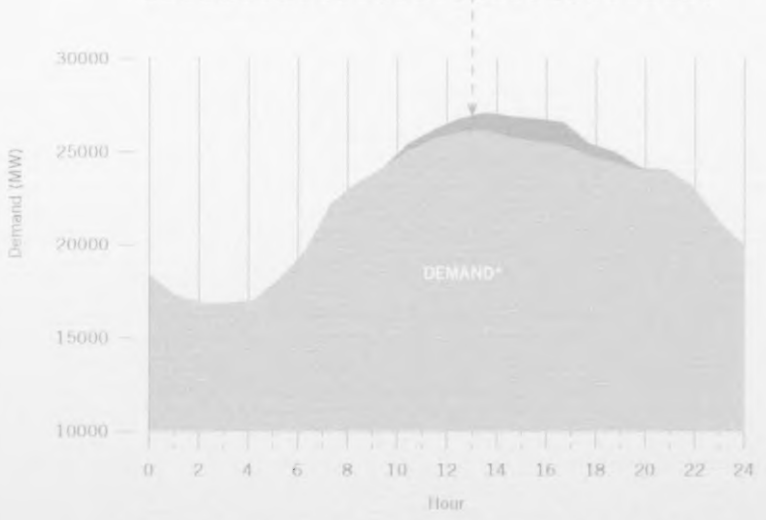
THE YEAR THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, THE FORERUNNER TO ONTARIO HYDRO, FIRST USED A DIGITAL COMPUTER (UNIVAC II) TO EXPERIMENT WITH OPTIMIZING ITS ENERGY SCHEDULING.

20,000

APPROXIMATE NUMBER OF DATA POINTS GATHERED BY METERS ACROSS THE PROVINCE AND SENT TO THE IESO EVERY THREE SECONDS.

IMPACT OF DEMAND RESPONSE

DEMAND REDUCTION
Demand reduced as a result of price measures and demand response programs. Over several hot summer days in 2013, demand response helped reduce peak demand by an average of 1,200 MW.



*Ontario demand as supplied from the grid as well as estimate of demand supplied by embedded generation.

Capacity markets are flexible enough to allow for the full range of services that demand response providers can offer, which are largely dependent on how they operate their facilities, what kind of machinery they use and their overall energy needs. A one-size-fits-all approach to demand response would limit the amount of demand response that can ultimately be made available.

Jurisdictions that have introduced capacity markets report noteworthy results, such as lower all-in costs, more predictable prices and significant increases in demand response participation. Capacity markets also offer the flexibility to integrate innovations such as energy storage and other emerging technologies. While the costs for some of these technologies may not currently be competitive, this is changing quickly due to the pace of technological advances.

Throughout 2014, the IESO will be working to develop a capacity market and consulting with stakeholders on a "made in Ontario" approach that reflects the sector's unique circumstances.

Bruce Campbell reinforces the need to adapt for the future: "Over the past few years, the grid has capably handled the demands made of it. But we can't continue to do things in the same way we always have. Nuclear refurbishments, new technologies and consumer needs won't wait for a time that's convenient for us and, one way or another, they will all affect our business. Exactly how may not yet be clear, but for some of us this potential new world will be a made-to-order opportunity. At the IESO, we want to manage these changes, and not have them manage us."

2,300 MW

NEW FLEXIBILITY FROM ONTARIO'S NUCLEAR UNITS
THE EIGHT UNITS AT THE BRUCE GENERATING STATION, FOR EXAMPLE, CAN CHANGE OUTPUT BY MORE THAN 2,300 MW, PROVIDING A REMARKABLE AMOUNT OF FLEXIBILITY FOR A BASELOAD RESOURCE.

BEHIND THE SCENES AT THE IESO

EDWARD ARLITT

A 14-year veteran of the IESO, senior strategic analyst Edward Arlitt witnessed – and worked on – the initial implementation and ongoing evolution of Ontario's wholesale electricity market.

Arlitt, who graduated with an M.Sc. in information systems from the London School of Economics, initially worked on the development of Market Rules. Other projects followed, including the implementation of the IESO's Day-Ahead Commitment process and later, the IESO's Smart Metering System Implementation Program.

Today he is involved in the IESO's corporate strategy development, helping integrate new demand response initiatives into the market, and serves as the IESO's representative on various smart grid-related forums.

"I enjoy my current role," he says. "It allows me to stay abreast of the latest trends in technology and electricity."

HANY HABIB

Reducing the time it takes to perform a business process from seven days to two days is impressive.

Multiplied 2,200 times over three months, this one improvement becomes a real boon to business efficiency.

That is the story behind the IESO's automated registration process for market participants.

Hany Habib, a software engineer with the IESO's Business Solutions group, served as the lead developer on the process.

"There are so many benefits to automation," says Habib, who graduated with a B.Sc. in computer engineering from Ain Shams University in his native Egypt. "Efficiency, fewer human errors, and of course it frees up staff to do other work."

EVOLVING TO A MORE EFFICIENT ELECTRICITY MARKETPLACE

The IESO is looking to stakeholders to provide advice and input on how best to integrate significant changes in the management of the power system.

Here are some of the crucial questions facing the industry today, and the types of criteria used to evaluate options, and ultimately an approach to evolve the market.

THE DISCUSSION:

How can the system leverage the growing contribution of renewables?

How should Ontario explore the potential of microgrids and nanogrids?

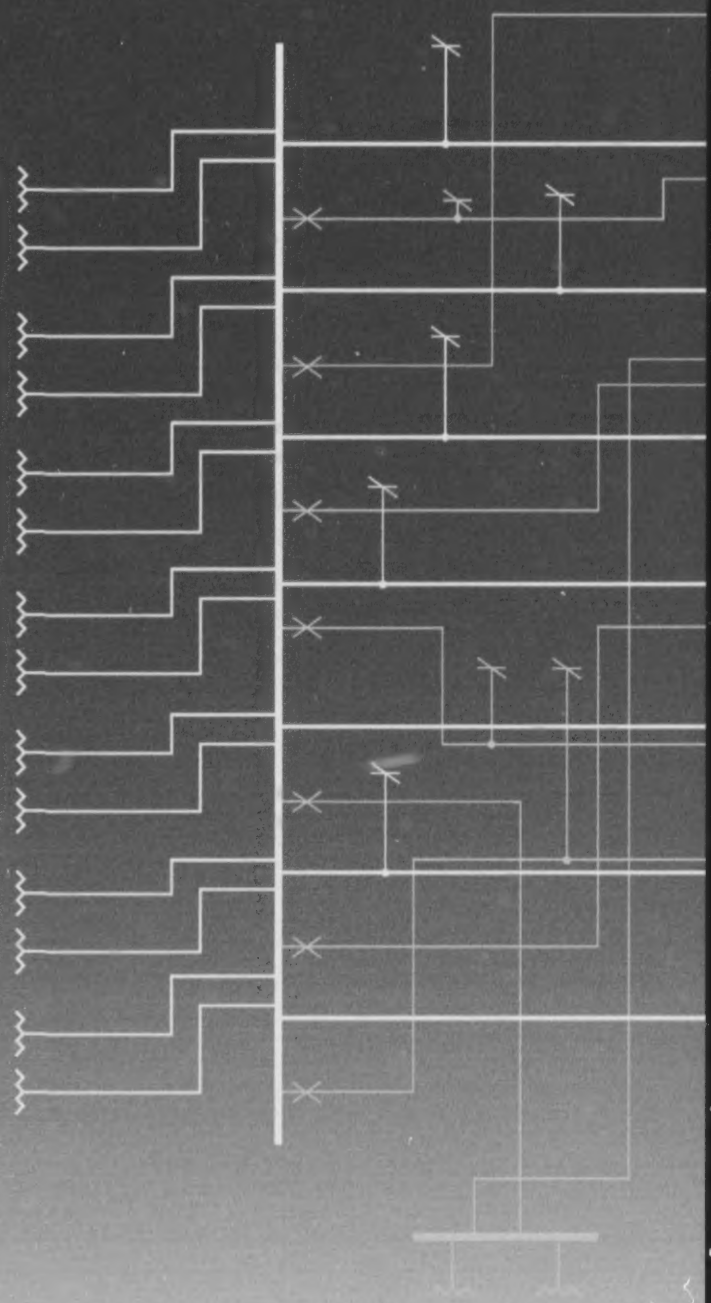
How do we best integrate energy storage into the system?

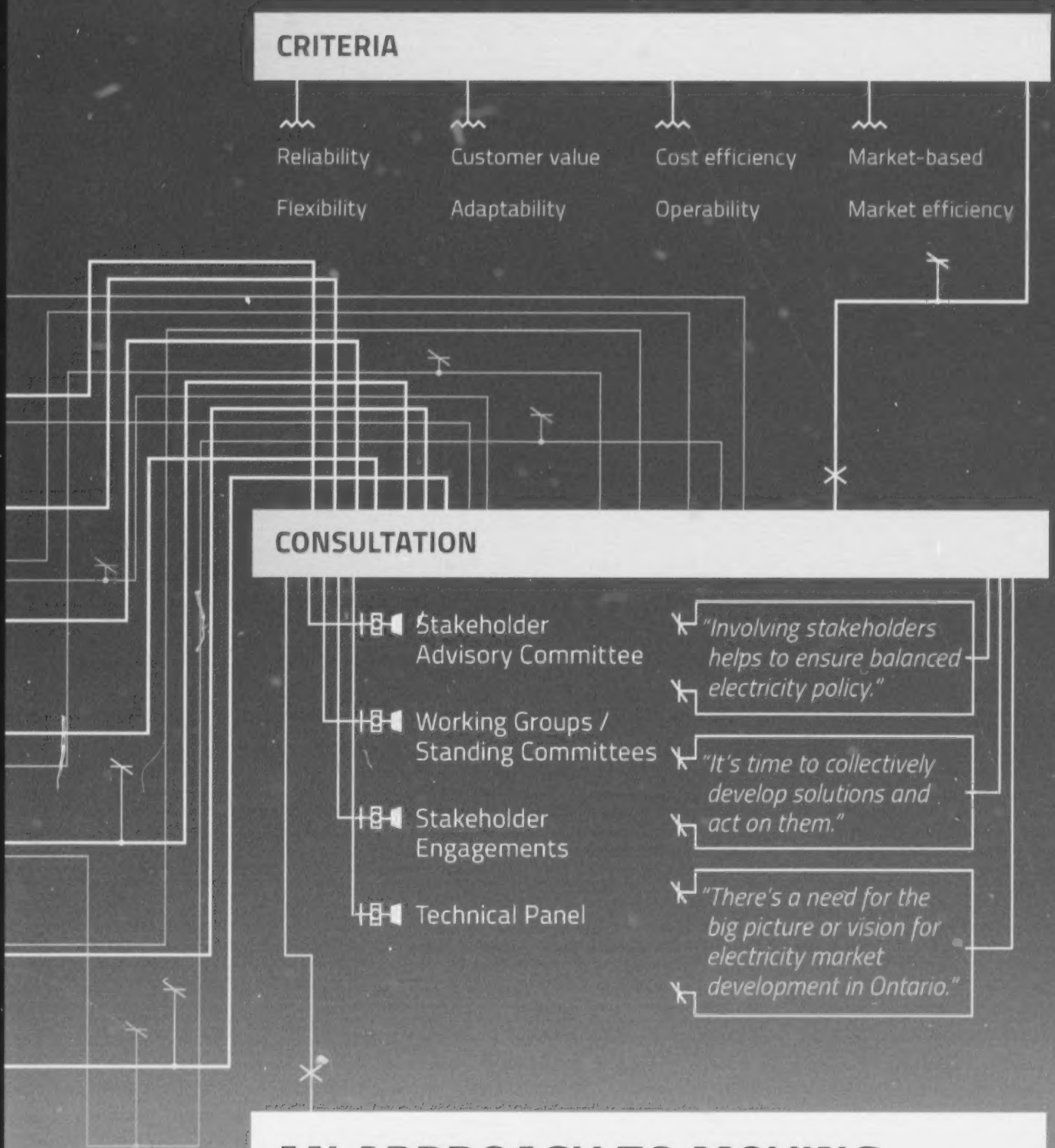
How can demand response better address system needs?

What are the benefits of having a capacity market in Ontario?

What market or pricing signals will consumers use to change their consumption?

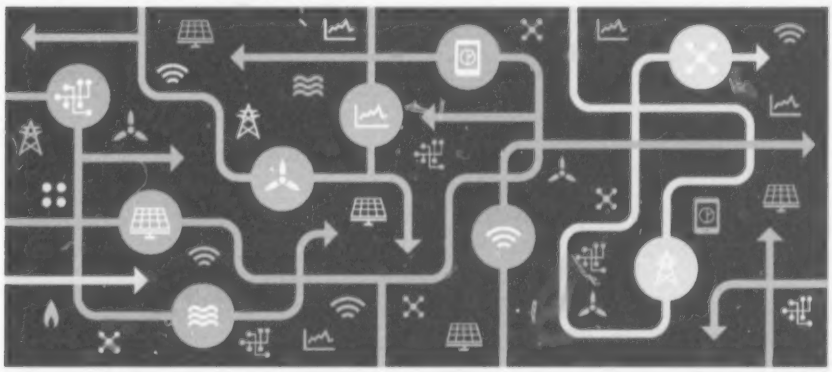
How does Ontario ensure new technologies compete on a level playing field?





AN APPROACH TO MOVING THE MARKET FORWARD

Ontario's Smart Grid – Five Years On



Technology moves fast in the digital world. In 2008, the iPhone was just starting to revolutionize the cellphone market. Netflix had just opened its doors to give subscribers unlimited access to streaming video. And the Ontario Smart Grid Forum – whose members represent utilities, associations, public agencies and universities – started its work to achieve the vision of a smart grid for Ontario.

Since it was founded, the Forum, with the support of the Corporate Partners Committee, has explored a myriad of smart grid-related issues, advocating for a coordinated approach to smart grid development. While these groups act as independent bodies, the IESO supports the Forum's ongoing efforts – with IESO President and CEO Bruce Campbell acting as its current Chair.

Ontario has placed itself well ahead of most other jurisdictions around the world in terms of smart grid development. With more than 4.8 million smart meters installed in homes and businesses and almost all low-volume consumers on time-of-use rates, the province has created the basis for a smart grid. But as the Ontario Smart Grid Forum noted in its five-year assessment, this leading position might not last long.

According to some estimates, the number of Internet-connected devices exceeded the number of people on Earth sometime in the year 2008 – the very year the Smart Grid Forum was founded. Using current estimates, that number could grow to more than 25 billion by as early as 2015.

A smart grid is just one part of a growing trend toward the 'Internet of things' that will provide greater connectivity, control and capacity for automation and responsiveness – perhaps at an astonishingly fast rate of growth. The Smart Grid Forum has been anticipating this development for some time now – though the greatest challenges may lie just ahead.

The United States, South Korea, Japan, Brazil and various members of the European Union have all made smart grid development a priority. Open standards, investment in research and development, and consumer demand are leading the way to a proliferation of new approaches to managing electricity use. Depending on how one counts smart grid-related spending, estimates of the size of the global market for smart grid-related products and services range from $73 billion to $400 billion by 2020. It is no wonder that countries are looking to develop smart grid technologies to add value to their export portfolios.

Indeed, smart metering only scratches the surface of the potential for smart grids. New industry clusters for energy storage, demand response, home energy networks, smart appliances and distributed generation are emerging in Ontario and elsewhere. These capabilities may drive efficiencies across the electricity system, but they also generate high-value jobs that strengthen the province's economy.

As competition picks up, Ontario will need to become even more focused on demonstrating its capabilities to the world. Local distribution companies are implementing smart grid projects to accommodate small-scale generation and changing customer demands. Established technology companies, start-ups and Ontario's research institutions are strengthening the entire innovation chain. For its part, the IESO is examining its rules and processes in order to create opportunities for all types of services and technologies to compete to provide for the province's needs.

In the coming months, the Forum and the Corporate Partners Committee will discuss the emerging implications of connecting smart electrical grids and other energy systems such as thermal storage, combined heat and power and natural gas. They will continue to advocate for ways that Ontario can extend its lead in the fast-paced smart grid world.

Learn more about various smart grid technologies and the work of the Smart Grid Forum on the IESO website at www.ieso.ca.

A 360° VIEW: STAKEHOLDER PERSPECTIVES

Q1. What do you think has been the most significant change to take place in the market over the last few years? What were the benefits of this change? What lessons can be learned from it?

ROB COULBECK

VICE PRESIDENT ENERGY MANAGEMENT
GOREWAY STATION PARTNERSHIP

"The most significant change in the IESO wholesale market has been the renewed emphasis on stakeholder initiatives as a result of the Electricity Market Forum. The IESO and market participants have already seen the positive impact through the implementation of rules to address surplus baseload generation.

Ongoing stakeholdering will further enhance and evolve the market by evaluating all aspects of the current market and undertaking new initiatives to unearth potential efficiencies. Whether the changes are minor modifications, clarification of existing rules, overhaul of the unconstrained market price or new products (capacity market and day-ahead market, for example), we look forward to building on the cooperative efforts of the IESO, OPA and market participants, which will lead to more efficient operation of the market."

JATIN NATHWANI

PROFESSOR AND ONTARIO RESEARCH CHAIR IN PUBLIC POLICY FOR SUSTAINABLE ENERGY
EXECUTIVE DIRECTOR, WATERLOO INSTITUTE FOR SUSTAINABLE ENERGY (WISE)
FACULTY OF ENGINEERING AND FACULTY OF ENVIRONMENT, UNIVERSITY OF WATERLOO

"Ontario can take pride – and some solace – in the fact that we have put the crisis of inadequate energy supply behind us. Coupled to this stable generation environment is the achievement of the near-herculean task of closing the coal plants and putting Ontario's electricity sector on a low-carbon trajectory for generations to come. This will, over the long term, prove to be the envy of jurisdictions around the world, and more so, those U.S. states that surround Ontario.

The emerging challenge to Ontario's economic prosperity is the underlying threat embedded in the contracts of some high cost variable generation that will put upward pressure on cost to consumers. The enablement of a smart grid – another important Ontario achievement – has the promise and the potential to become a powerful tool in the hands of consumers to help mitigate the impacts of upward cost pressures.

The magic we have achieved is this: Ontario's low-carbon electricity sector has transformed itself into a driving force to embolden Ontario to become a modern energy economy based on electrified mobility and smart urbanization."

Q2. What emerging opportunities are there for the industry to ensure that the system becomes more sustainable, efficient and responsive to consumer needs? How can it best prepare to take advantage of these opportunities?

ED SEAWARD

MANAGER, MARKET DEVELOPMENT, UNION GAS

"Ontario is widening its definition of smart grid to smart energy network – a grid that uses advanced communications technology to monitor and measure energy use not just for electricity but for natural gas and other sectors. This inclusive smart energy network can improve the flexibility and resiliency of the power grid. For example, natural gas and electricity are linked in terms of generation. In a world of smart energy networks, those same connections could be expanded on the consumer side. There are opportunities for commercial and residential customers to help manage peak demand with technologies such as Combined Heat and Power (CHP), micro CHP, gas heat pumps or natural gas cooling.

For smart energy networks to happen, working together is key. In Ontario, energy policy tends to largely be focused on electricity policy, with less attention on natural gas policy. Both systems have robust energy delivery infrastructure – transmission and distribution for electricity, and transportation and distribution for natural gas. To fully utilize this infrastructure, we must look at connecting the two systems beyond the large generation level, moving to foster downstream consumer applications."

BARRY CHUDDY

CHIEF EXECUTIVE OFFICER, GUELPH HYDRO INC.

"The system we have is pretty good but could be adapted to be a better fit for sustainability, efficiency and a reduction in harmful emissions as communities are accepting their obligations to reduce our carbon footprint. In order to be more sustainable and efficient, the rules on dispatch could be modified to recognize that CHP plants have some unique attributes and benefits, and as a system we want more of them, not the large gas-fired combined cycle plants that have predominated the market. Also, I think the economic dispatch of generation needs to consider its greenhouse gas effects and 'price this in'. The location of generation and its dispatch needs to reflect the fact that we do want more generation closer to the load, and avoid transmission losses."

WAYNE SMITH

SENIOR VICE PRESIDENT, GRID OPERATIONS
HYDRO ONE INC.

"Our customers need to see the value. Our supply of electricity and the markets that support it must make sense to them and be trusted. In the industry today, much of the complexity and competing dialogue can lead to quite the opposite. We need to embrace emerging ideas like automation, microgrids, renewable generation and social media in a way that improves and simplifies the experience for the customer. Accepting that the priorities differ for different customers, our customers need to be part of driving the investments we make. We also need to ensure this core infrastructure remains secure and reliable. Innovating with the vendors of the equipment that makes up our power systems and as an industry is key to maintaining or improving reliability and security. If we don't innovate, both will degrade."

Q3. What fundamental shifts are needed to prepare the system for changes over the medium and longer terms?

ERSILIA SERAFINI

PRESIDENT, SUMMERHILL

"I believe that building a Culture of Conservation and 'Conservation First' must be integrated into all energy-related decisions including system planning and infrastructure investment. We need to accept that conservation benefits consumers and society. We need to move to a state where conservation efforts are no longer confined to silos, compartments or channels but rather are a fully integrated approach in our system. Finally, we need greater coordination from all stakeholders understanding that the same fundamental approach applies whether it is electricity, natural gas, oil or water conservation."

RON DIZY

PRESIDENT AND CEO, ENBALA POWER NETWORKS

"Today's power system requires flexibility – it is no longer sufficient to think of the grid's needs in terms of energy and capacity. As the current power system continues to evolve and new forms of generation are brought online, procuring this flexibility is becoming a real challenge. In order to manage intermittent renewable energy, fluctuating demand and other evolving grid management issues, grid operators need to be aggressively working with and piloting alternative sources of flexibility – including demand-side management-based solutions and energy storage technologies. At the same time, we must explore and begin shifting to different mechanisms to effectively compensate energy resources for the value they bring to grid operations."

RON DEMBO

FOUNDER AND CEO, ZEROFOOTPRINT SOFTWARE INC.

"Looking at other industries around us, empowering the consumer has become the focus of many corporations – and this type of thinking is creeping into the electricity industry. Consumers want to be empowered to do things like better manage their electricity use to reduce their cost and consumption.

This fundamental change in thinking can all come together in a world of 'big data' and 'open data'. Harnessing the possibilities of data and smart consumer products will help improve efficiencies not just in energy, but in a variety of sectors. Consumers want their electricity meter at home, their water meter and even meters that track personal health to give them information not just for curiosity's sake but to use it for a purpose. Open data, especially at the IESO, which is at the nexus of smart meter energy data, will allow developers to design phone apps for consumers to get paid for managing energy with the touch of a finger."

5 WAYS TO ENGAGE WITH THE IESO

1. REACH OUT TO THE STAKEHOLDER ADVISORY COMMITTEE (SAC)

Stakeholder Advisory Committee representatives provide advice and recommendations on market development and planning decisions directly to the Independent Electricity System Operator (IESO). Members representing electricity service providers, generators, conveyors and electricity consumers reach out to their constituents to gather input to help develop their recommendations. Upcoming meetings are listed at www.ieso.ca/sac.

2. JOIN A STAKEHOLDER GROUP OR ATTEND A MEETING

The IESO consults with stakeholders affected by a particular change initiative so they can provide input before a decision is made. Consultation channels include active consultations, working groups, standing committees and the Technical Panel. For more information, visit www.ieso.ca/se.

3. ATTEND THE ANNUAL STAKEHOLDER SUMMIT

The IESO Stakeholder Summit gathers speakers and panelists from across the Ontario energy industry and beyond to discuss key topics to further the development of the electricity market. Watch for the 2015 Summit announcement and read the 2014 Summit report at www.ieso.ca/summit.

4. TALK TO US

IESO Customer Relations representatives are available from 8 a.m. to 5 p.m., Monday to Friday, to answer your questions. Subscribe to the weekly Info Bulletin to stay informed about news, notices, updates and events. Email **customer.relations@ieso.ca or call 905.403.6900/1.888.448.7777.**

5. FOLLOW THE IESO ON SOCIAL MEDIA

Get an inside look at how the IESO and electricity market are run. The IESO posts company and industry news, and answers questions from stakeholders and the general public.

Facebook:
www.facebook.com/OntarioIESO
Twitter:
www.twitter.com/IESO_Tweets

The IESO is responsible for delivering maximum value to ratepayers, and has built a culture of fiscal restraint and prudent spending. To access a copy of the IESO 2013 Financial Statements, visit www.ieso.ca/annual.report

Independent Electricity System Operator
655 Bay Street, Suite 410
P.O. Box 1
Toronto, Ontario M5G 2K4

Phone: 905.403.6900
Toll-free: 1.888.448.7777
Fax: 905.403.6921
E-mail: customer.relations@ieso.ca

www.ieso.ca
www.twitter.com/IESO_Tweets
www.facebook.com/OntarioIESO

ieso

Power to Ontario. On Demand.